
Biodiversity & Human Health

Module 4 • i2P • Biodiversity



“This we know: the earth does not belong to man: man belongs to the earth... All things are connected like the blood which unites one family... Whatever befalls the earth, befalls the sons of the earth. Man did not weave the web of life: he is merely a strand in it. Whatever he does to the web, he does to himself”.

- Chief Seattle in a letter to U.S President Franklin Pierce in 1855



When the i2P team embarks on its trek down the Tapajos River in Brazil, team members will be taking medication to prevent malaria. Malaria is widespread in tropical countries, and can be deadly if left untreated. However, should one fall ill, there are medications available to treat the illness, one of which is Quinine. Quinine was the first effective treatment against malaria, and its medicinal properties were discovered by the Quechua Indians of Peru, who extracted it from the bark of the cinchona tree. Quinine is still used today in modern medicine, as are many other drugs isolated from a range of natural sources.



Figure 1: The bark of the *Cinchona* tree from which Quinine is produced (source: [H. Zell](#))

The diversity of life on Earth is essential to human health. Throughout history, mankind has relied upon the diversity of plants, animals and ecosystems to support the basic human need for food, shelter, clothing and clean water. Houses have long been built of wood or vegetation appropriate for the local climate. At one point traditional clothing was derived exclusively from local animals or plants. The relationship between human needs and ecosystems still exists today, but it's not as clear to many in the modern world. Manufacturing, marketing and modern agricultural technology have distanced consumers from a direct relationship with nature and local ecosystems. Many remain blissfully unaware of how important biodiversity still is in providing the necessities of life and maintaining human health.

FOOD SECURITY

Human beings are omnivores, meaning that we eat both plants and animals. Our source of food is the natural world around us. Traditionally human beings obtained food by hunting and gathering, which meant that they ate whatever plants and animals were available to them locally. This began to change about 10,000 years ago when agriculture was invented, crops were sown and livestock was tended. Over time, promising species of plants, like rice and wheat were given precedence. And animals like cows and chickens were introduced around the world, replacing local species. But the spread and standardization of agricultural species has limited the number of sources from which humans get their nutrition. Currently, 12 species of animals provide 90% of the protein consumed globally, and incredibly, only 4 crop species provide 50% of plant-based calories in the human diet (see: [Biodiversity and Food Security](#)). In fact, the Food and Agriculture Organization of the United Nations estimates that over the last century, three-quarters of the genetic diversity in agricultural crops has been lost. This loss of biodiversity not only limits our diets, but decreases an ecosystem's resistance to climate change, and threatens the sustainability of current crop yields. The loss of diversity of crops and livestock put human food sources at greater risk of mass failure.

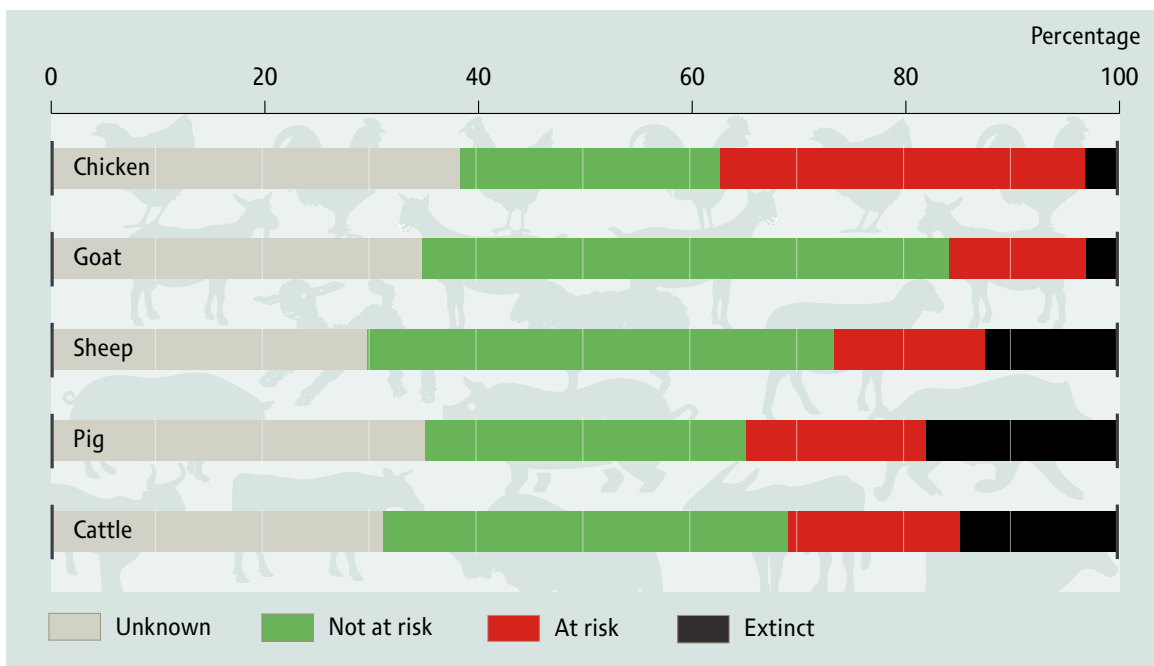


Figure 2: Genetic diversity among the five major livestock animals is decreasing as certain species are selected for large-scale breeding (Source: [Secretariat of the Convention on Biological Diversity](#))

The biodiversity of the pollination process is also integral to food security. Pollination is the process by which pollen is carried from one plant to another promoting fertilization and reproduction. The unsung heroes of this process are the insects that distribute the pollen. As many as 80% of crops rely upon insects for pollination. But some plant life rely on very specific insects.

A decrease in insect populations, therefore, can result in poor crop pollination, and ultimately decreased food production. (see: [Biodiversity's Role in Pollination](#)).

Did You Know?

Wetlands provide a great deal of this natural water filtration, retaining 80 to 90 percent of pollutants in runoff sediment. Today, wetlands are threatened in many locations by pollution and urban development.

see: [wetlands](#)

WATER

Biodiversity also plays a key role in ensuring ample stores of clean, fresh water. Plants and trees that line streams and rivers carry out a natural filtration process. These living water filters pull metals and pollutants from running waters and deposit these impurities on the river's banks. Deforestation and urbanization, however, are eliminating or degrading these natural water filtration systems. This sets off a potentially irreversible process in which water becomes progressively contaminated, threatening the well-being of other plants, animals and humans that live nearby (see: [Natural Water Filtration](#)).

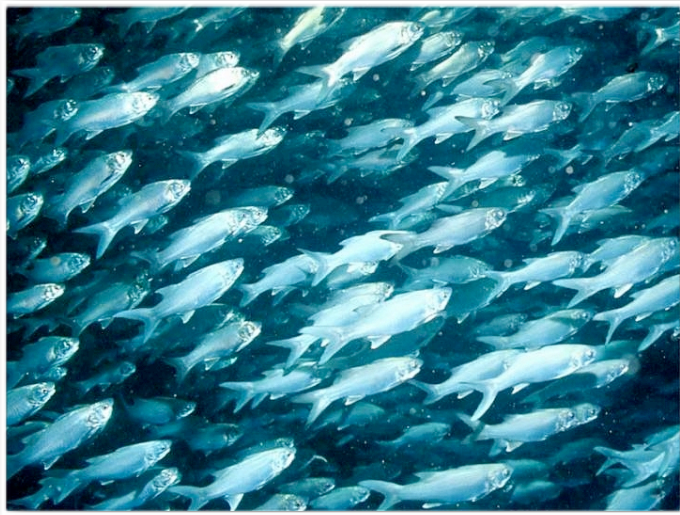


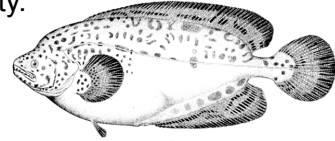
Figure 3: A school of six-finger threadpins circling inside a fishery cage off the shore of Hawaii (Source: [NOAA Photo Library](#))

FISH

More than 3 billion people - nearly half the world's population - rely on marine biodiversity for their food and/or livelihood. This is especially true in developing nations, where as many as 1 billion people depend on fish as their primary food source.

While fishing has long been a practice of human populations, modern fishing techniques threaten both the size and diversity of fish species. The Food and Agricultural Organization of the UN estimates that more than three-quarters of

the world's fisheries have already been harvested close to, or beyond, their biological limit. What's more, scientists estimate that due to over-harvesting, 29% of all fish, shellfish and invertebrates that people consume as food are down to only 10% of their previous populations. Research has shown that the decline in species diversity appears to leave ecosystems more susceptible to species specific deterioration, a trend that could result in a complete global fishery collapse by 2048 (see: [Global Collapse of Fisheries](#)). The loss of global fish stocks will have grave implications for humanity.



NATURAL DISASTERS

In addition to sustaining food resources, biodiversity also plays a role in mitigating natural disasters. This is illustrated by the capacity of mangrove forests to protect coastline and cities (see: [Mangrove](#)). The roots of mangrove forests stabilize coastal erosion and diminish the effect of rising floodwaters from hurricanes, typhoons and tropical storms. Scientists have found that mangrove forests are more effective than man-made levees at buffering inland cities from the threat of surging floodwaters. Studies by the Army Corps of Engineers suggest that every 2.7 feet of wetlands extending out into the ocean can reduce storm surges by one foot.

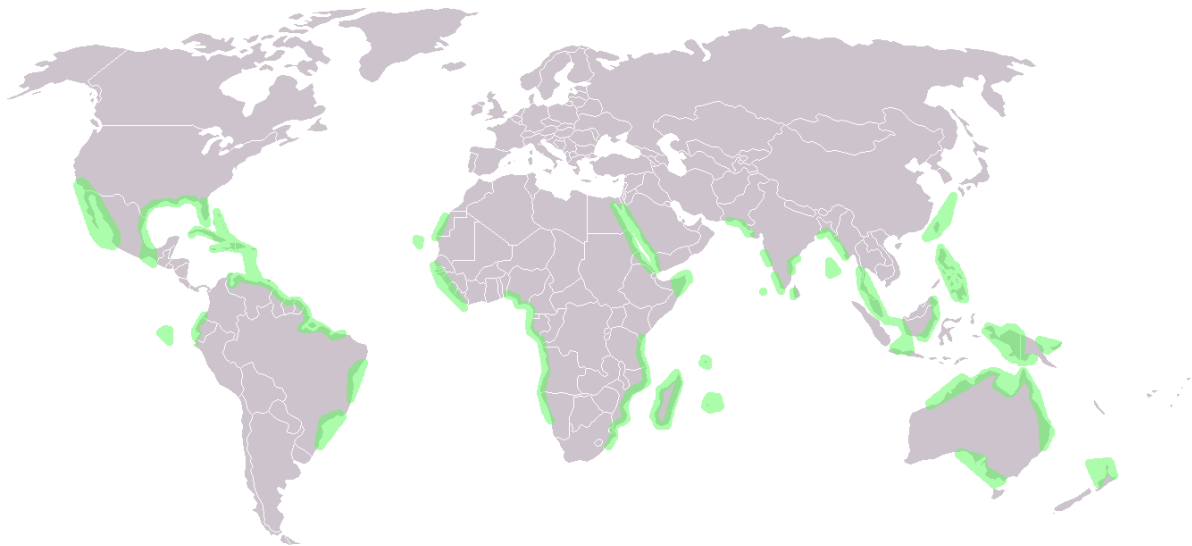


Figure 4: World Map of Mangrove distribution (source: [Pinpin](#)). From their wide distribution the extent of mangrove forests ability to protect shoreline is a global benefit.

Salt marshes, wetlands and other coastal ecosystems provide similar protection, but today these ecosystems are declining due to coastal developments and unsustainable logging practices. Bangladesh, for example, has lost more than 70% of its coastal mangrove forest. Similarly the wetlands of the Mississippi delta and those buffering the

city of New Orleans from flood waters and storm surges are disappearing at a rate of 16,000 acres each year - this equates to a plot of land the size of a tennis court disappearing every 13 seconds (see: [National Wetlands Research Center](#)). Experts argue that the destruction and flooding caused by Hurricane Katrina would have been much less severe had the wetlands that surround the area been preserved. Experts further caution that without a reversal of current trends, the Gulf of Mexico will extend inland an additional 30 miles by the year 2050, leaving even more people exposed to natural disasters (see: [Hurricane on the Bayou](#)).

BIODIVERSITY & DISEASE

Biodiversity is also a direct buffer against disease in human beings, according to University of Vermont biologist Joe Roman, and his co-authors,:

"Habitat destruction and biodiversity loss, driven by the replacement of local species by exotic ones, deforestation, global transportation, encroaching cities, and other environmental changes can increase the incidence and distribution of infectious diseases in humans" (see: [human disease](#)).

Habitat destruction through deforestation has long raised alarm bells as a significant driver of climate change, soil degradation, species extinction, and an altered water cycle. Two studies have now shown that the risk of malaria is greater in newly deforested areas. According to research conducted in Peru the biting rate of *Anopheles darlingi*, the Amazon's main malaria-spreading mosquito, was nearly 300 times greater in cleared areas than forested ones (see: [malaria](#)).

Studies have also demonstrated a link between the loss of biodiversity and increased rates of Lyme disease. Lyme disease is caused by a bacteria that is transferred to humans by the deer tick. Deer ticks in turn are infected with the bacteria by any number of different small mammals. However the mammal that best transmits the Lyme bacteria is the white footed mouse. A loss of biodiversity in the American north-east has been shown to favor the white footed mouse, as many of its natural predators such as owls



Figure 5 : Tick of the species *Ixodes hexagonus* (source: [André Karwath](#))

and foxes are decreased in number. The increase in the population of white footed mice results in greater transmission rates of Lyme disease (see: [Lyme](#)).

Similar spreading of infectious disease due to a loss of biodiversity have been observed with Hantavirus, West Nile Virus, Schistosomiasis, SARS, Ebola, and Avian Influenza (see: [Biodiversity Loss Affects Global Disease Ecology](#)).

DRUGS

Plants have long served mankind as a source medicine to fight illness. Records as far back as 2600 B.C. detail the use of cedar, cypress, opium poppy and licorice in treating common ailments. Today, in developed nations, 25% of prescriptions dispensed from pharmacies contain plant extracts or chemicals derived from plants (see: [Biodiversity and Human Health Report](#)).

Among the commonly used medications that are derived from plants are Quinine (tree bark), Morphine (opium poppy), Artemisinin (Chinese plant), Taxol (tree bark), Curare (South American vine), and Pilocarpine (Jaborandi plant). Other drugs are derived from animal, bacterial and fungal sources, the most famous example being the discovery of the fungus penicillin in 1928 (see: [natural medicine](#)).

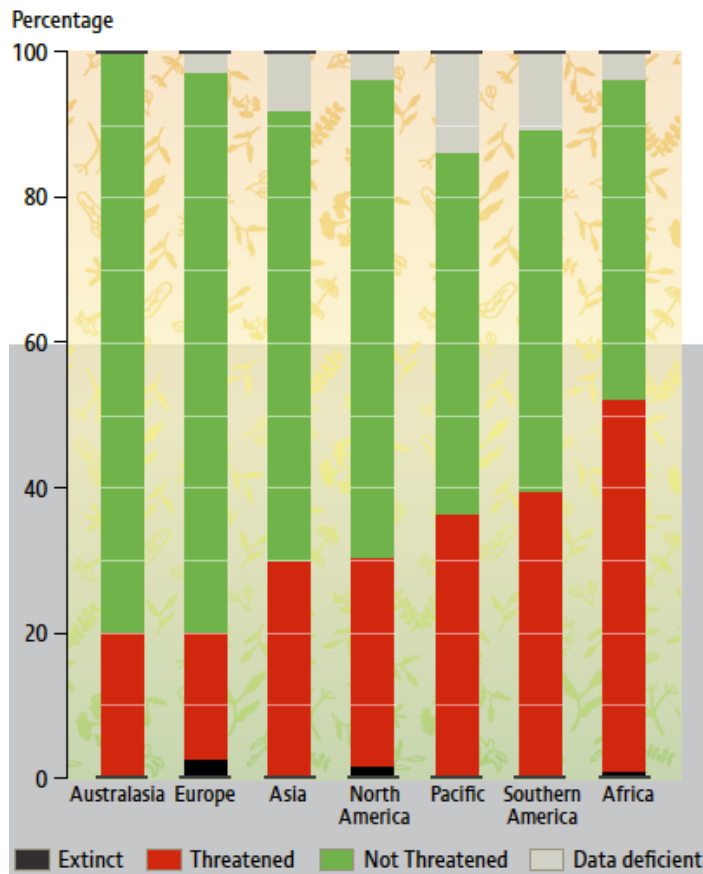


Figure 6 The conservation status of medicinal plants in various global regions. Unfortunately the highest numbers of threatened plants are in regions where traditional, medicinal plants are most widely used (source: [Secretariat of the Convention on Biological Diversity](#)).

Given current global loss of biodiversity, a concern is that undiscovered treatments will be lost with the destruction of plants and animals (see: [Are We Killing the Plants That Can Cure?](#)). Many traditional medicines in use by indigenous

Did You Know?

The gila monster is a lizard native to Mexico and the Southwestern United States. Scientists have studied the venomous saliva of the gila monster and found that it contains a protein that can be useful for the treatment of diabetes. This discovery has led to the development of a drug called “Byetta”, now prescribed for the management of type-2 diabetes.

Gila monster saliva has also been found to contain a substance called gilatide. Early studies have found that this substance enhances memory in mice, and may hold the key to the treatment of such disorders as Alzheimer’s or Attention Deficit Hyperactivity Disorder (ADHD).

see: [Gila Monsters and Human Health](#)

peoples today (see: [Traditional Medicines of Tomorrow](#)), may have wide application as legitimate treatments for human disease, but are threatened by the loss of biodiversity. One such ecosystem that offers great promise as a source of medical therapies, are coral reefs. Coral reefs are currently being explored for their potential to provide cures to AIDS and various cancers (see: [Coral Reef Medicine Research](#)), but are undergoing unprecedented worldwide degradation.

TIPPING POINT

The relationship between human health and the biodiversity of the Earth are intimately woven. The immense pressure placed on the Earth by the exponential growth of the human population, and our thirst to consume the natural resources of the planet, place our collective well-being at risk. If we do not preserve the life forms with whom we share this planet, we run the collective risk of eating ourselves out of a home.

